GLACIAL STUDIES IN GREENLAND. II.

THE GLACIERS OF DISCO ISLAND.

VERY much of the deep interest felt in the glaciation of Greenland springs from the light it throws upon the former glaciation of our own country and of Europe. In the region of the old drift of the middle latitudes, the only glaciers that now exist belong to the small mountain type. These very imperfectly represent the modes of action of continental glaciers. It is natural therefore to turn for light to the polar ice-fields, which alone approach continental dimensions. But this approach to equality in dimensions and similarity in general habit is attended by a possible, if not a probable, difference in the special effects of latitude. If, to be sure, the ancient glaciations were caused by changes of latitude, these differences might not exist. But this hypothesis, like all other hypotheses relative to the origin of ancient glaciation, is at present open to very serious sources of doubt. It is not safe, therefore, to assume like latitudes. The peculiarities of glacial action due to latitude are therefore to be sought out, and, if need be, taken account of in drawing comparisons between the ancient glaciation of low latitudes and the present glaciation of high latitudes.

It is not difficult to find a partial basis for the elimination of these special effects. The great ice-field of Greenland ranges through something more than twenty degrees of latitude, *i. e.*, it stretches from about Lat. 60° N. to a limit but partially known, somewhere beyond Lat. 82° N., according to Lieutenant Peary. The former glaciation of the United States reached somewhat south of Lat. 38° N. It hence appears that the old glaciation stretched just about as far south of the southernmost extremity of the present ice-field of Greenland, as this ice-field now stretches north of that point. The difference between the

more southerly and the more northerly glaciers of Greenland may therefore give us a clue to what may have been the effects of double that range in former times.

The southern extremity of Greenland is, however, affected by the presence of the polar current of East Greenland and its heavy ice pack, which wraps about Cape Farewell and flows up the west coast several degrees, as already described. On this account a comparison between the more genial tracts immediately north of this and those of higher latitudes may be as representative as one drawn between the extreme portions. At any rate, this is the only comparison I can make, as my observations south of Disco Island were extremely limited. So far, however, as their very slight value goes, it appears that the Disco Island glaciers are of the same type as the glaciers of like dimensions in the more southerly region. In the following descriptions an endeavor will be made to call attention to all those peculiarities which seem to be serviceable in distinguishing the special effects of latitude. Among these special effects it is not meant, of course, to include those general influences of low temperature simply as such, to which the glaciation is due, but rather those which are inherent in the latitude as an astronomical relationship; such effects, for example, as may be attributed to the low angle of incidence of the sun's rays, or to its constancy above the horizon, or to similar phenomena involving peculiar effects aside from low temperature.

Politically speaking, Disco Island belongs to "Northern Greenland." Godhaven, the capital of the "northern inspectorate," is located on its southern border. In reality, however, Disco lies south of the middle latitude of Greenland. It ranges in latitude between 69° 15′ and 70° 20′ and in longitude between 51° 70′ and 54° 80′. The glaciers we are to study lie just north of Lat. 69° 15′ N. They are therefore but little within the Arctic circle. They are eight and one-half degrees south of those which we shall study a little later on Inglefield Gulf.

Disco is the largest of the known islands associated with

Greenland. Should the mass of land seen by Lieutenant Peary, north of Independence Bay, prove to be an island, as is highly probable, it will doubtless be found to surpass Disco in extent. The island is essentially a lofty plateau, ranging in height between 2000 and 4000 feet, with peaks rising to 5000 feet. Its borders are generally precipitous, but broken by valleys which are usually narrow and steep, penetrating but short distances. On the western side, however, there are developed very notable amphitheaters by the broadening and mesa-like recession of the upper parts of the valleys. On this side also there are three notable fjords, the Disco, Mellem, and North fjords. The first of these reaches nearly half across the southern portion of the island. The southern face of the plateau, as seen on the approach to Godhaven, is bold but not angular nor serrate. A somewhat symmetrical wall rises precipitously from near the water's edge to the height of 2000 to 2500 feet, where it is surmounted by an undulating plain that appears to represent an ancient surface. The face of the wall is broken at frequent intervals by steeply descending ravines, cut by small streams. The boldness of the frontage appears to be due to the work of the sea, but sea action has not recently been so effective as to prevent the accumulation of very large masses of talus along the foot of the cliffs, accompanied by a measurable recession of the upper part of the wall. The topography plainly indicates an ancient process of leveling, with a base-plane some 2000 feet higher than the present. It also indicates that this did not reach completion, and that a very long interval of greater elevation followed, during which a lower plain now near the sea level was partly developed at the expense of the older one. In this the fjords and deeper channels were cut. The present boldness of frontage toward the sea is probably due to the sea's action subsequent to the formation of the lower plain as may be inferred from its freshness and steepness.

The geological structure in the vicinity of Godhaven is quite simple. At the water's edge, and rarely rising more than 100 feet above it, lies a series of gneisses, resembling in all

general respects those of the Laurentian formation. A low hook of this gneiss running out from the base of the cliffs, and embracing an arm of the sea, forms the little harbor of Godhaven. Although here confined to the horizon of the sea level, it is evident that the gneissic series is more than a simple basement of the island, for the glaciers that come down from the ice cap bring bowlders of gneiss, from which the inference is safe that the series rises to the summit at no great distance back from the sea frontage. Apparently the later rocks are built about a nucleus of ancient gneiss.

Resting unconformably upon the gneissic series is a mass of irregular basic igneous rock, largely a volcanic agglomerate, rising somewhat more than a third of the way to the summit. This is exceedingly irregular in structure. Some parts of it are but a rude agglomeration of very coarse volcanic fragments of the roughest type. Although but obscurely bedded, taken as a whole it constitutes a rude stratum upon which, in turn, rises a very regularly bedded igneous series which constitutes the upper and more symmetrical portion of the cliffs. This series appears to consist of very uniform basaltic flows, separated by clastic volcanic material, a portion of which is a bright red silt-rock, whose high color gives distinctness and conspicuousness to the bedding. This regularity of bedding and the symmetrical degradation of the series, with its brownish aspect, gives it, at a distance, much the appearance of some of the Triassic and Tertiary terranes of brown sandstone.

The sandstone series that is well known to occur in the island was not observed in the immediate vicinity of Godhaven, but a few miles north, in the valley of Blase Dale, it appears abundantly in the drift in places, and may be occasionally seen *in situ*.

Along the sides of the valleys which cut back into the plateau the bedded volcanic series at the top usually gives rise to vertical or steeply sloping faces, while the rough massive agglomerates form irregular embossments in the lower slopes and bottoms of the valleys. The bedded series degrades the more rap-

idly, and retires by stopes, mesa-fashion, with a notable tendency to form amphitheatres. The valleys are therefore well suited to receive and develop glaciers.

The most notable of these valleys in the vicinity of Godhaven is the Blase Dale or Windy Valley. Through this flows the Red River, whose waters are tinged by the débris of the reddish shales and the red part of the igneous series. This valley is perhaps a mile in width, measured between the bluff faces, and is stiffly joined on either hand at nearly right angles by valleys of considerable breadth, but short length. The Blase Dale reaches back almost due northward, with moderate acclivity, for perhaps fifteen or twenty miles. Its full length was not seen, and the maps of the interior are imperfect.

Into the tributaries of this valley three glaciers descend from the west and two from the east, within eight miles of its mouth. The first three are derived from the snow cap which covers the southwestern portion of the plateau; the last two come from a much smaller snow cap on a dissevered portion of the plateau on the opposite side of Blase Dale. The snow cap on the west side of the valley so nearly occupies the plateau immediately overlooking Godhaven, that its border may be seen from the village through a short valley cut by a brook in the face of the escarpment. The base of the ice cap, according to the charts and the descriptions of Dr. Rink, is about 2500 feet above tide. At the time of our visit, both in July and September, it was covered with fresh snow to its very edge. We did not therefore climb to it, as it seemed more profitable to spend our limited time in the examination of the better exposed portions of the glacial tongues derived from it. Three of these glacial tongues were visited. They descend from the snow cap by cataracts across the horizon of the bedded igneous rocks, until they reach the broader, gentler portion of their respective valleys, where they reshape themselves into plump, solid glaciers, and creep on down to points varying from 900 feet to 1500 feet above the sea.

We shall perhaps encounter in their most natural order

those features in which students of American and European drift are most interested, if, instead of beginning our study here, we start at the sea level and follow up the valley until we reach the ends of the present glaciers, as we shall thus see the work formerly done by the once more extensive ice.

The gneissic rocks at the sea level, especially those that surround the harbor of Godhaven and stand out somewhat from the bluffs, are thoroughly smoothed after the well-known fashion of glaciers. They are so well subdued as to constitute an aggregation of fairly well-formed *roches moutonnées*. The ice movement was here from the *eastward,* not from the overhanging ice-crowned cliffs to the north. In other words, the line of motion was tangent to the southern shore of the island, not normal to it. Extremely little drift or débris of any kind has been left upon the surface here. There is abundant evidence of "plucking," and numerous little basins cover the low peninsula south of the harbor, but the material so derived was almost wholly borne away. The principal part of what remains is of the same nature as the rock on which it rests, and hence the erratic material gives us little aid in determining whether the ice movement which wrought upon the surface came down from the interior of the island through Blase Dale, as far as its mouth, and then turned westward at right angles, and crossed this low outlying hook, or whether the movement was part of a more general one from the eastward, caused by a former extension of the great inland ice cap of Greenland, which now has its border some fifty miles to the east. The latter seems to be much the more probable hypothesis, for reasons that will appear later.

On entering the mouth of Blase Dale, it is remarkable that the drift is found to be very scant. This can be attributed to no inability of the valley to retain drift, for its slopes are sufficiently gentle and its streams sufficiently confined to definite channels to permit the retention of drift if it were ever lodged there. Nor can it be attributed to any uncertainty of observation, for the surface is essentially bare. Occasional clumps of willows occur, mosses are somewhat abundant, and there are not

a few flowering plants, all the more noticeable and grateful for their persistent blossoming in spite of the hostile elements, but none of these, nor all together, essentially obscure the surface. Portions of the valley well suited to retain drift are almost entirely free from it. Here and there are some small aggregations, and in some of the valleys there are considerable accumulations, although in some of these instances it is uncertain what part is due to stream action, what to local disaggregation, and what to glacial transportation. But whatever may be the result of a strictly correct analysis of such mixed deposits, the general fact remains that the glacial drift in the valley is exceedingly scant. That there is some, however, is beyond question, for, besides other evidence, there are here and there gneissic bowlders which are sharply distinguishable from the igneous rocks that form the entire bottom and sides of the valley, and these are perched in such situations and have such forms and markings as to show that they are the relics of a glacier that formerly occupied the valley.

The contours of the bottom and lower slopes of the valley have taken on phases consonant with the scant drift. While in general the outlines are referable to meteoric and aqueous erosion, and their general configuration is of the usual degradation type, they are slightly rounded and subdued, after the glacial fashion. A few shallow basins occur, for which no assignable agency other than ice seems available. Nowhere, however, are the spurs, ridges, or other embossments of the valley subdued to a distinct moutonnée type. No glacial striæ were observed, except in the immediate vicinity of the present glaciers. These characteristics prevail throughout the valley up to the immediate vicinity of the present glaciers. No terminal moraine was found stretching across the valley at any point below, but at the ends of the present glaciers notable terminal moraines are being formed. The scantiness of the marks of this former glaciation of Blase Dale, compared with the strong markings on the little Godhaven peninsula, affords grounds for the view already expressed that the glaciation of the latter was a part of a more

general and more powerful movement from the east rather than an extension of the local glaciation of the island.

Ascending Blase Dale amid such feeble tokens of former ice action, and turning to the left into the wide mouth of the first tributary valley, we reach the lowest of the Blase Dale glaciers at a height of about 1500 feet above the sea.

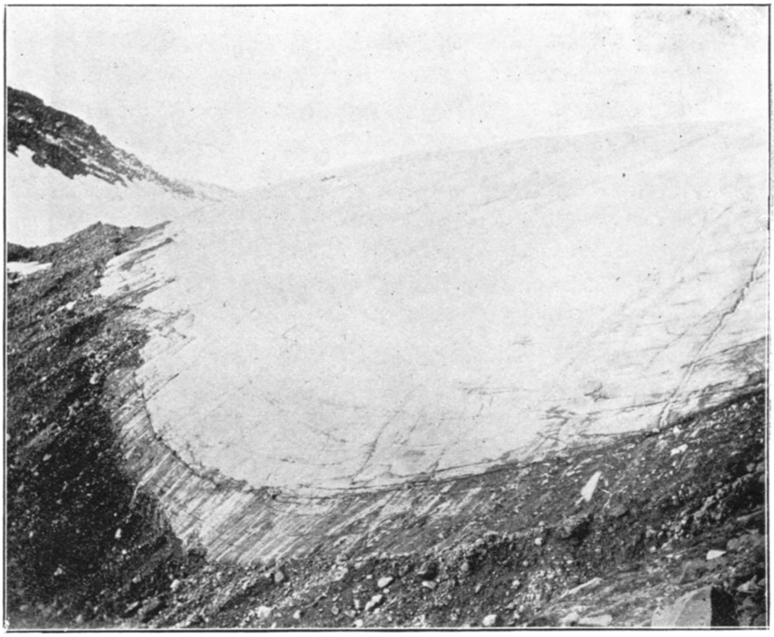

FIG. 6.—Portion of the end of Lower Blase Dale glacier in the west valley, showing terminal slope and the relations of the ice to the morainic material.

Lower Blase Dale Glacier.—This glacier descends from the ice cap by a steep, much-crevassed cataract. An embossment of rock in the center causes the ice to break over it and fall in fragments to the base of the declivity, where it again solidifies and moves on with the branches on either hand that succeeded in descending without complete disruption. These branches correspond to the heads of two valleys that jointly make up the common valley. These diverge gently below the cataract, leav-

ing a broad, low ridge between them. But the glacier is sufficiently massive to embrace them both, and bridge over the intervening divide. The effect of the ridge, however, is a slight incurving of the frontal margin of the glacier in passing over it, and the development of two imperfect terminal lobes, one occupying each valley.

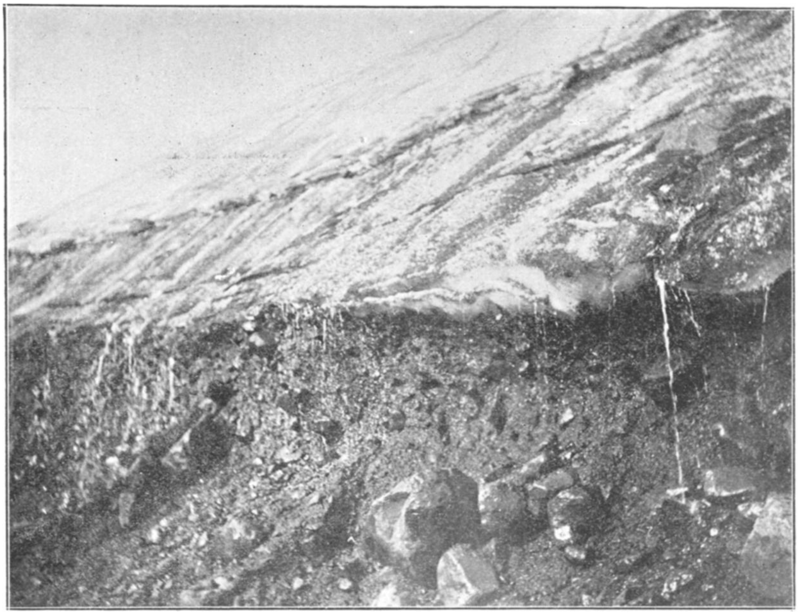

FIG. 7.—Nearer view of a portion of the extremity of the Lower Blase Dale glacier shown in Fig. 6, illustrating the superposition of the ice upon its morainic material.

At the time of our first visit, on the 16th of July, the edge of the ice and the terminal moraine on this divide were not only concealed by snow, but so deeply buried that the limit of the ice and even the existence of the terminal moraine could only be inferred from adjacent exposed portions. On reaching the crest of the glacier, we found that the larger part of its surface also was still buried in snow. In places it even then retained a depth of three feet or more, which greatly impeded progress,

not to say observation. In September, this had entirely disappeared, but, as already remarked, snow still covered the ice cap above and lay upon the cataracts, and to some extent upon the higher lands adjacent, as will be seen by referring to the photographic illustrations. These particulars, which have little importance in themselves, are introduced here to show the climatic conditions under which these glaciers are formed and maintained. They illustrate the extreme shortness of the season

FIG. 8.—Portion of the end of the Lower Blase Dale glacier on the divide between the two valleys, showing the relation of the ice to the morainic material.

during which effective wastage is brought to bear upon the glacier proper. The full inference from this, however, should doubtless not be drawn, because the season appears to have been somewhat more than usually severe.

At the later date, the character and relations of the terminal moraine were fully revealed. On the saddle between the two valleys the moraine was sharply developed as a little ridge lying immediately against the present ice and rising a few feet—rarely the height of a man—above it. In the valleys, the glacier

pushed out upon its moraine, and lay above it, and, at points. even projected over it, so that it was quite impracticable to walk along the edge of the ice on the débris. Figs. 6 and 7 show the relations of the ice to its moraine in the westernmost of the two valleys. Fig. 8 shows the relation of the glacier to its moraine on the divide between the two valleys. In the latter it will be seen that the terminal moraine is but a small bowldery ridge, formed at the immediate foot of the glacier. A little of the snow drift that obscured the whole moraine in July may still be seen at the right of the picture. In the former it will be observed that the morainic material lies directly beneath the edge of the ice. The glacier even projects a little in the central portion, so that the streamlets of water fall free in front of the drift beneath (Fig. 7). There is a débris-bearing horizon in the ice, about fifteen feet above its base, as shown in the figure. This is but the outcropping edge of a layer of dirty ice, which, besides silt, carries pebbles and stones of moderate size, and an occasional bowlder. Below this there is some débris in the ice, but its amount is small. The wash of the silt over the surface as it melts gives an exaggerated impression of its amount in the photographs. A similar statement may be made of the débris on the whole terminal margin of the glacier. At some points there are layers of ice a few inches thick, which are well set with erratic material. This, as it comes to the surface, gives rise to little heaps or ridges upon the ice, at points a few feet back from the moraine. These heaps or ridges present the appearance of having been forced out from the ice, but this is in part due to the fact that the débris covers the ice and retards its melting, so that it comes to take the conical form so well known on Alpine glaciers. When the loose material is cleared away, the débris is usually found to be confined to a thin layer solidly imbedded in the ice. In some instances, however, the débris was found set free by melting for some distance back between the layers of purer ice, and hence it may have been subject to outthrust by the movement of the ice. Certain instances were found in the Inglefield Gulf region where this had undoubtedly

taken place. But, for the most part, this apparent outthrust was seemingly due to differential melting.

Little needs to be added to the photographic illustrations to make clear the nature and disposition of the terminal material. It is aggregated immediately at and under the ice edge. On its external face it is usually heaped about as steeply as the material will lie. It is composed of rocky material mixed with clay. Gravel is occasionally present, but is only a very minor constituent. The mixture of rock and clay is indiscriminate and varying. It differs little from the well-known stony till produced

FIG. 9. Illustration of the bruising, de-angulation and partial rounding of the bowlders of the terminal moraine.

by Alpine glaciers, where the rock element is abundant and the grindings take the form of clay rather than sand, as is the case with most basic igneous rocks. The bowlders are commonly bruised and de-angulated in various degrees. They are sometimes, but not usually, well rounded. In a moderate degree they are polished and striated in typical glacial fashion. The amount of wear, however, is only moderate. It is far less than the average wear suffered by the bowlders of our Pleistocene drift, as would be expected from the shorter transportation. Fig. 9 illustrates fairly well the nature and degree of reduction. This

was taken on the outer slope of the terminal moraine. A few rods from this point an exposed surface of the underlying rock exhibited characteristic grooving and polishing [Fig. 10].

The waters produced by the melting of the edge of the glacier flow over the terminal moraine in little streamlets at various points along its course. To some slight extent, the waters gather between the edge of the ice and the inner side of the moraine, and run for short distances parallel to the ice edge until they find a lower point in the moraine, when they pass across it. As they descend the outer slope, they separate some of the smaller

FIG. 10. Striated surface just outside of the terminal moraine.

fragments from the mass and slightly round them, producing incipient gravel, but, owing to the rockiness of the morainic material and the shortness of the outer slope of the moraine, this work is very trivial. It however, represents a work that attained very great importance on the outer side of some of our ancient moraines.

The formation of the moraine is in itself a demonstration of the movement of the ice, but it gave no indication of vigor of movement. No opportunity was offered for instrumental measurement, but the natural signs of movement were sought with little result. At the time of our first visit, as already remarked, an immense snow drift covered the border of the ice, the moraine, and a portion of the rock surface outside, yet I saw no signs of

the crushing or crumpling of this bridging drift, such as might have been expected had the ice pushed forward to any notable degree during the existence of the drift. And again, our tracks, impressed upon the soft crest of the little moraine only a few feet back from the border of the ice during our July visit, remained intact and undisturbed on our visit in September. I could not see any clear signs of thrust or disruption in the interval. Beyond question some motion must have taken place, but it was so slight as to fail to indicate itself by such signs as these.

Ascending from the moraine to the glacier, the terminal slope of the ice becomes a matter of interest, in view of the comparisons we shall have occasion to make with the glaciers of Inglefield Gulf, eight and a half degrees farther north. On the saddle between the two minor valleys, or, in other words, in the central part of the end of the glacier, the terminal slope of the ice is so moderate as to admit of easy ascent. In the valleys on either hand the slope is such as to forbid ascent except by resort to the ice axe. On the lateral borders the ascent is again more gentle. In no case however, is there a vertical wall of ice; the line of ascent is a beautiful curve. Attention is especially invited to this because it is in consonance with glaciers of lower latitudes, but in contrast with the prevailing habit in the far north.

Within a few rods of the border, a much gentler slope is reached which gradually grows lower until at a distance of perhaps half a mile, it seems even to be reversed and to descend toward the cataract on the border of the ice-capped plateau. Instrumental measures do not however confirm the impression, but such descents in a direction opposite to the movement of the ice do occur, as we shall see presently.

After leaving the immediate vicinity of the terminal moraine the surface is found to be practically free from pebbles and bowlders. A small amount of dust discolors the surface, a part of which has doubtless been blown upon it and a part of which is probably derived from the ice. A few crevasses traverse the portion of the glacier visited; but these are mostly small and longitudinal. In the main they are old and snow-filled.

In a word of summary, it may be remarked that the glacier conforms to the usual habit of Alpine glaciers of low latitudes. Its surface and terminal contours are of the same type. Its débris, where it does not take the form of lateral and medial moraines, is found in the basal portion of the ice, and does not appear at the surface except in the immediate terminal zone.

The Middle Blase Dale Glacier.—To pass from the glacier just described to the next on the west side of the Blase Dale, it is not necessary to descend to the bottom of the valley. A moderate climb over a low intervening spur and a corresponding descent brings us into the open valley partly occupied by the middle glacier. The precipitous sides of this valley diverge at a wide angle. Its bottom is a broad platform stretching from cliff to cliff and extending a half mile perhaps in front of the glacier beyond which it descends by a steep terrace into the Blase valley. The general form and relations of the glacier and its moraines are so well shown in the photographic illustration, Fig. 11, that little need is left for verbal description. In all its essential characteristics it belongs to the same type as the lower glacier. Its moraine is much more massive and better developed. The point of observation is such as to make the moraine in the central and left portions appear to be rather lateral than terminal, but the little medial moraine at the left shows that the direction of movement is essentially normal to the margin, except at the extreme left. The profile shows the crest and terminal slope of the ice, but it fails to bring out the undulatory nature of the ice surface. On ascending the eastern or right hand portion to the first crest, we were surprised to find an actual descent into a very considerable valley, from which the surface again rose to a second crest. In this valley a little lakelet had accumulated. Fig. 12 shows imperfectly the depression of this valley into which one of my companions had descended so far that only his head and shoulders remained visible. Of course the trustworthiness of the illustration depends on the accuracy of the leveling of the instrument, but the formation of the lakelet, and the descent of the streams into it,

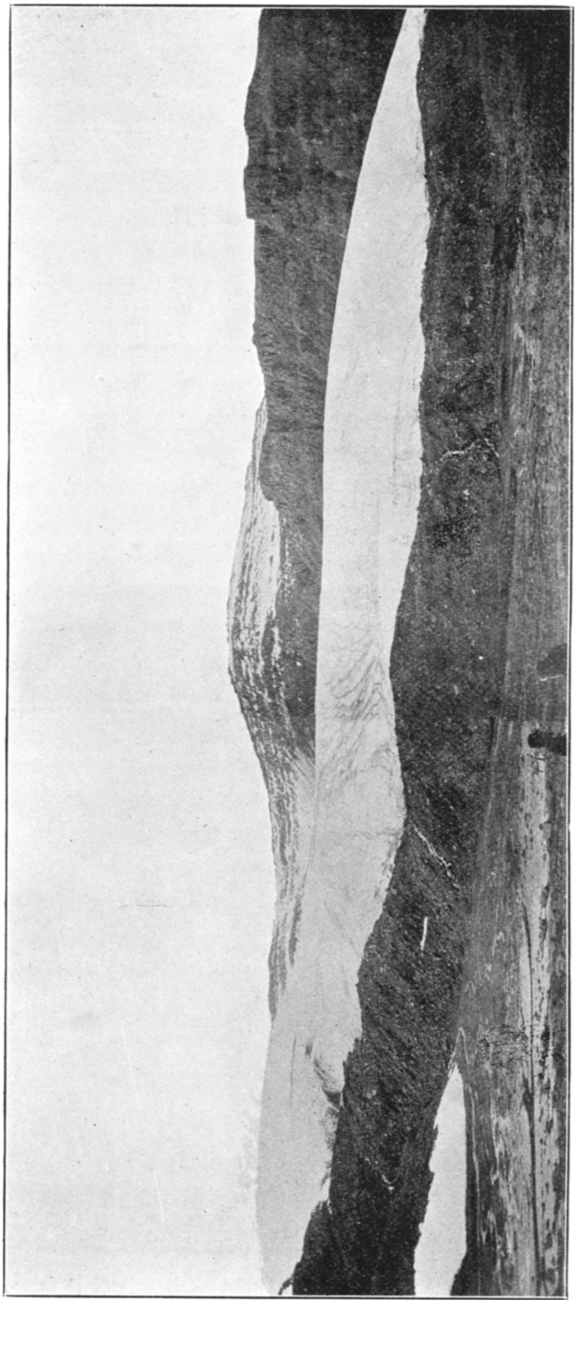

FIG. 11. General view of the Middle Blase Dale glacier and its moraine.

are sufficient evidence that its surface slopes in a direction *opposite* to the movement of the ice. An instance will be given later, in the Inglefield Gulf region, where very considerable surface streams were found flowing *directly opposite to the motion of the ice*.

As in the preceding case, almost no drift occurs upon the surface of the glacier except where there are medial moraines.

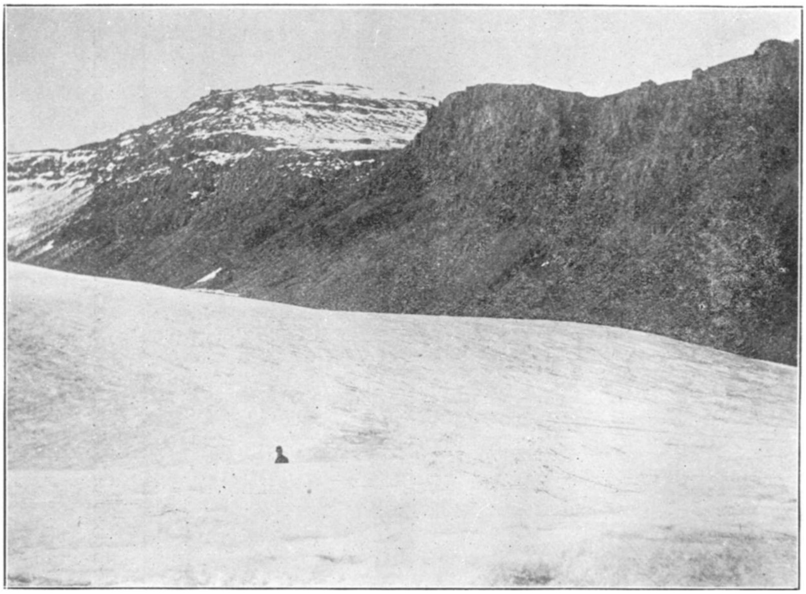

FIG. 12. View of a portion of the middle Blase Dale glacier showing the undulation of its surface involving a backward inclination.

The material from which the terminal moraine is built is derived from the base or basal layers of the glacier. The elevation of the end of the gracier is approximately 1600 feet above the sea.

Upper Blase Dale Glacier.—Without either descending to the bottom of Blase Dale or climbing over the heights, it is possible to pass up the valley to the next glacier by taking advantage of a terrace shelf that passes along the face of the cliffs. Beyond it connects with a much more considerable terrace which

gradually broadens until it is wider than the Blase valley itself. At a distance of about three miles, a tongue of ice, very much more massive than either of the preceding, descends from the ice cap through a broader and deeper incision of the plateau face, and stretches entirely across the broad terrace just mentioned, and descends its face almost to the bottom of Blase Dale. At the point where it emerges from the cliffs of the upper plateau it develops strong lateral moraines which extend entirely across the high terrace, and even down its edge into the axis of the Blase valley. The outer lateral moraine on the right, bears evidence of greater age than the terminal moraines of the two glaciers already described. It is notably weathered and covered with vegetation in the partial fashion of the region. There is nothing to indicate age beyond a few hundred years, but it is notably older than the exceedingly fresh moraines we have already encountered, as it is also notably more ancient than the fresh lateral moraine that lies within it. Its material is very rocky and angular. Between it and the edge of the ice there is a more complex moraine consisting of several parallel ridges. The inner edge of this is so intimately associated with the margin of the ice, and its material extends out upon the border of the ice to such an extent as to make it difficult to determine just where the one ends and the other begins.

A very notable medial moraine is borne on the back of the glacier some distance out from its southern margin, but it joins the lateral moraine before reaching the terminus of the glacier. The crevasses of this glacier are more notable than those of the preceding, and besides the true crevasses, there are numerous fracture lines traversing some portions of the surface which seem to be due to internal strains that do not demand the opening of the crevice when once formed. They cross the laminæ, or blue bands, of the ice (which here run parallel to the sides) taking a course obliquely *forward* but curving toward the center of the glacier. Their course is thus seen to be the opposite of that of the normal crevasses on the border of a glacier. They are obviously a fine subject for investigation, and I much regret that

time did not permit me to make more full and critical observations.

This glacier terminates on the steep terrace face shortly before reaching the axis of the Blase valley, and does not develop as distinct a terminal moraine as the two lower glaciers. The lateral moraines maintain great strength down to the terminal curvature, and in some degree close in at the end of the glacier. The terminal face of the ice is steep, but not vertical. Débris embraced in the lower part of the ice comes to the surface on this terminal slope as in the preceding cases, but apart

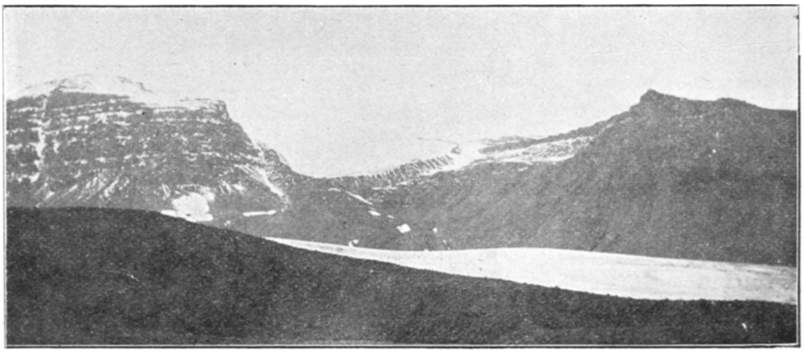

FIG. 13.—View of the Circumvallate glacier, with the Upper Blase Dale glacier and its lateral moraine in the foreground.

from this and the lateral and medial moraines, the surface is generally free from rocky material.

A circumvallate glacier.—Just north of the Upper Blase Dale glacier, and almost overhanging it, is an interesting little glacial lobe, snugly walled in by a sharp, serrate terminal moraine. This will be seen in the central part of Fig. 13, in the saddle between the prominences at the right and left. The view was taken from the south side of the Upper Blase Dale glacier. It is notable chiefly for the sharpness and symmetry of the moraine, and the contrast between it and the rocky surface around it. Outside of this moraine on the right, it will be observed, there is a wind drift accumulation of snow. This is of little moment

here, but it is a phenomenon that acquires much importance in north Greenland, and will invite special consideration because of its peculiar effects on the formation of the terminal moraine. Here it does not appear to exert any influence on the moraine. It illustrates the persistence of the deeper winter snows throughout the summer. There had been a recent fall of snow, as the residue on the adjacent heights testifies, but this accumulation was obviously not due to it. The photograph was taken on September 2.

FIG. 14.—Distant view of the upper east side glacier, seen from the back of the Upper Blase Dale glacier, looking eastward across the Blase Dale valley.

The east side glaciers. — Time did not permit me to visit the glaciers on the east side of the Blase Dale, but Fig. 14 is introduced to show the general aspect and relationships of the uppermost of the two seen on that side. The view was taken from the back of the Upper Blase Dale glacier, looking eastward across the valley. The view also illustrates in some degree the summit topography of the region and the nature of the broad upper valleys into which the ice lobes descend from the still higher ice caps. The east side glaciers give the impression of

great thinness and flatness as compared with those of the west side. This was more notably true of the lower one. They nevertheless have lateral and terminal moraines of small dimensions, but no moraines were seen in the valleys below them.

Comparative features. — The general characteristics of the glaciers of Disco Island are closely similar to the southern Alpine type. They present the same forms of lateral, medial and terminal moraines; the same surface contours; the same terminal slopes; the same freedom from drift on the general surfaces, except as medial moraines, are superposed, or internal drift comes out to the surface on terminal slopes. There is the same habit of forming cataracts on steep descents, and of crevassing at points of more moderate strain. The Disco glaciers differ from typical Alpine glaciers in their less obvious activity. They also differ in that they come from ice caps on relatively flat plateaus instead of amphitheaters or mountain slopes or ravines. This distinction is not absolute, for ice caps occur among Alpine glaciers.

It does not, therefore, appear that these glaciers present any distinctive effects of latitude beyond the results of the low temperature that makes them possible at such moderate elevations. If we shall find a difference in the Inglefield Gulf region, its cause will be one that comes into play chiefly between the Arctic circle and the region far within it, rather than between the Arctic circle and the middle latitudes.

It is prudent to note, however, that these are but local ice caps and local glaciers. The great ice cap of southern Greenland and its dependencies may not have the same habit. At the far north, however, the local ice caps and their dependencies have the same habits as the great inland field and its dependencies. This gives ground for the belief that the features displayed in the Disco region are representative of southern Greenland generally. I have not found the descriptions of the southern Greenland glaciers sufficiently detailed on the points in question to warrant a wholly confident interpretation, but I do not recall anything inconsonant with this. T. C. CHAMBERLIN.